SAMPLING AND ANALYSIS PLAN
FLINT HILLS RESOURCES ALASKA
NORTH POLE REFINERY LABORATORY AREA
SCREENING GROUNDWATER INVESTIGATION

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Submitted To:
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TABLE OF CONTENTS

TABLE

FIGURE

APPENDICES

ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	Chain of Custody
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
FHR	Flint Hills Resources Alaska, LLC
FT	field technician
GRO	gasoline range organics
HCl	hydrochloric acid
L/m	liters per minute
µS	microSiemens
mL	milliliter
NPR	North Pole Refinery
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RRO	residual range organics
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
VOC	volatile organic compound

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INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared to guide a screening investigation of shallow groundwater quality in the vicinity of the Flint Hills Resources Alaska (FHRA) quality-control (QC) laboratory. In July 2010, a static pressure test of the laboratory drainage piping indicated the subsurface piping system would not maintain a static water level when the piping system was isolated and filled with water. On July 21, 2010, FHRA reported this test result by letter to the Alaska Department of Environmental Conservation (ADEC). This SAP provides sampling and analysis procedures for a screening evaluation of shallow groundwater quality in the vicinity of the QC laboratory.

Activities to be performed pursuant to this SAP include the installation and sampling of several temporary direct-push groundwater-monitoring wells near the QC laboratory. The investigation activities will provide information on shallow groundwater quality.

The scope of services to be performed under this SAP includes installing eight temporary monitoring wells to permit the collection of groundwater samples. Details regarding well installation are discussed in Section 2.1. The proposed temporary well locations are illustrated on Figure 1.

The following tasks are covered in this document:

- selecting of parameters and analytes;
- collecting of groundwater samples from temporary monitoring wells;
- preserving and handling groundwater samples;
- identifying analytical procedures and laboratory QC requirements;
- documenting field-sampling procedures, including sample identification and chain-of-custody (COC) protocols; and
- field quality assurance (QA) and QC procedures.

1.1 Data Use Objectives

The data will be collected to screen dissolved-phase shallow groundwater quality in the immediate vicinity of the QC laboratory.

1.2 Indicator Analytes

A table of chemicals and products used in the FHRA QC laboratory was submitted to ADEC in the FHRA submittal of July 21 and is presented in Appendix A for reference. Based on these data, the groundwater samples will be analyzed for the following indicator analytes:

- gasoline range organics (GRO);
- diesel range organics (DRO);
- residual range organics (RRO);
- volatile organic compounds (VOCs);
- semivolatile organic compounds (SVOCs);
- select metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver);and
- sulfolane.

1.3 Sample Locations and Rationale

The temporary monitoring wells will be installed at seven locations downgradient of the laboratory building. In addition, one location hydrologically upgradient from the laboratory building will be selected as a potential background location. The locations of the proposed monitoring wells are shown in Figure 1. The proposed locations may be adjusted in the field to avoid obstacles, utilities, or other subsurface appurtenances that may be present.

1.4 Deviations and Modifications to SAP

Deviations from the procedures discussed in this document may be implemented in the field. Deviations from the SAP and the purpose for the deviation will be clearly documented in the field log and detailed in a final report.

1.5 Schedule

The installation of the temporary monitoring wells is scheduled for late October so the work may be completed prior to the onset of cold weather. A draft Investigation Results Report will be completed within approximately four weeks of acceptance of final laboratory results.

1.6 Personnel

Jon Lindstrom of Shannon & Wilson will serve as the Project Manager. Additional Shannon and Wilson personnel who may perform groundwater drilling and sampling, depending upon staff availability, are Julie Keener, Andrea Carlson, Rodney Guritz, Kristin Williams, Catherine Hill, or Rick Wilbur. All are ADEC "Qualified Persons."

2.0 SAMPLE COLLECTION METHOD

The following subsections describe procedures for temporary-well installation and groundwater-sample collection.

The Shannon & Wilson field technician (FT) will collect and handle analytical samples in accordance with the ADEC *Draft Field Sampling Guidance*. Collection of QC samples will be according to procedures presented in Section 3.0.

2.1 Temporary Well Construction and Installation

Shannon &Wilson will retain the services of Homestead Drilling Company (Homestead) of Fairbanks, Alaska, to conduct the direct-push temporary monitoring-well installation. Groundwater sampling will be performed by Shannon & Wilson under the direction of FHRA personnel. FHRA will be responsible for verifying locations of underground utilities and marking locations suitable for installing the temporary wells.

Temporary wells will be designed, constructed, and installed in accordance with the ’DEC's *Monitoring Well Guidance* (February 2009).

Homestead will install the temporary monitoring wells using their hollow-stem auger drill rig fitted with direct-push equipment, using methods described below. Shannon & Wilson will collect groundwater samples from each well using the procedures described in Section 2.2. To the extent possible, wells will be sampled within a period of a few days, and the samples will be submitted to the commercial laboratory in one sample delivery group (SDG).

The temporary wells will be constructed of new or decontaminated 1.5-inch inside diameter, 0.02-inch slotted stainless steel pipe with a 4-foot-long slotted section. Stainless steel has been selected for this investigation due to its necessity for direct push application. The temporary monitoring wells will be installed after first cutting through the asphalt surface surrounding the laboratory. Homestead will mobilize their drill rig, cut or drill through the asphalt, and install the temporary monitoring wells in sequential order. The drill rig will be permitted to remain in the work area; drilling will be scheduled to avoid leaving a partially completed temporary monitoring well overnight. As requested by the ADEC, the temporary wells will be sampled at two depths to gather data regarding the vertical distribution of constituents in the shallow groundwater. Each well will be pushed first to 15 feet below ground surface (bgs) and sampled.

A depth of 15 feet bgs will ensure the entire 4-foot section of well screen is below the water table, which is approximately 7 feet to 10 feet bgs. Following sampling at the 15-foot depth, the well will be advanced to 25 feet bgs at each proposed location. The 25-foot depth approximately corresponds to the bottom of shallow monitoring wells previously installed nearby.

Following sampling, the temporary monitoring wells will be removed by withdrawing the well casing. If the temporary wells leave an open conduit to the subsurface following withdrawal of the casing, the open space will be grouted using bentonite pellets, concrete, or similar material. Areas of cut asphalt will be repaired with cold patch.

Temporary well construction information will be recorded on a Monitoring Well Construction Details form (Appendic B).

2.2 Purging and Sampling

Temporary monitoring wells will be purged and sampled using a portable, battery-operated peristaltic pump capable of continuous operation, described in the following sections. If cold weather makes use of the peristaltic pump impractical, e.g., due to water freezing inside the tubing, we will use a “microbailer” to purge and sample the wells.

Purging will be performed immediately prior to collecting groundwater samples from each monitoring well. Purge volumes will be recorded for each monitoring well by collecting and measuring purge water in a suitable container.

Purging will be performed using a flow-through sampling cell equipped with temperature, pH, conductivity, dissolved oxygen, and redox potential probes. These parameters will be monitored during purging and recorded at approximately three-minute intervals. When parameters have stabilized for a minimum of three consecutive readings, the discharge tubing will be disconnected from the flow-through cell, and the groundwater directed into the sample containers. New sample tubing will be used at each sample location and depth. The collected purge water will be disposed in the refinery’s oily-water sump system.

The indicator analytes to be measured in the groundwater samples are identified in Section 1.2. The use of a peristaltic pump may result in a low bias for certain VOC analytes due to volatilization at reduced pressure in the suction line. This possible condition may be of concern under compliance monitoring conditions, but for general analytical screening, use of a peristaltic pump is common practice.

If a microbailer is used to purge, it will not be possible to accurately measure groundwater parameters. The bailer will be slowly lowered into the well to minimize agitation of the water column; three well volumes will be purged from the well prior to sampling.

All purging and sampling equipment coming into contact with groundwater will be documented on the Monitoring Well Sampling Log (Appendix B).

The purge rate will be established as soon as practical after pumping begins; measured by catching the discharge from the pump in a volumetric container and measuring the time required to reach a specific volume. The operator will regulate the discharge rate of the pump so no more than 3.5 Liters per minute (L/min) is evacuated.

2.2.1 Measurement of Field Parameters

Monitoring wells will be purged and sampled using a portable peristaltic pump ("Geotech GeoPump 1", a 12-Volt DC pump) and new, disposable tubing. . The new tubing will be attached to the peristaltic pump and slowly lowered into the well to the specified depth (generally within the top half of the well screen, e.g., 13 feet for a 15-foot well) so it will not agitate the water. The pumping rate will be regulated for minimum agitation of groundwater in the well (3.5 L/min or 1 gallons/minute).

Temperature, conductivity, pH, dissolved oxygen (DO), and redox potential will be measured in a flow-through cell to determine the point at which sampling can begin, using a YSI ProPlus multiprobe analyzer or equivalent. Measuring devices will be calibrated at the start of the sampling day and checked at the end of the sampling day using known standards. All calibration data will be recorded in the field log.

Field parameters will be measured using a "flow-through cell" attached to the pump-discharge line, with the measuring device placed in the flow-through cell; readings for each parameter will be recorded regularly. All measurements will be recorded on the Monitoring Well Sampling Log. Any odor, color, or other apparent physical characteristics of the groundwater will also be documented on the form.

Purging of each well will continue until three consecutive readings of conductivity (µS), pH, DO(percent O_2), and redox potential (in millivolts; mV) have stabilized. The following values are used to indicate stability: ±3% µS, ±0.1 pH, ±10% DO, and ±10 mV redox. Sampling will begin when stabilization is reached. In the event the parameters do not stabilize, a total of at least five well casing volumes will be purged prior to sampling. The total volume of water purged prior to sampling will be recorded on the Monitoring Well Sampling Log.

2.2.2 Temporary Well Sampling

Each temporary well will be sampled immediately after purging is completed. The following paragraphs outline equipment and procedures for sampling temporary wells. New nitrile gloves will be worn during sample collection;, new gloves will be donned at each sample location to prevent cross-contamination.

Samples will be collected into new, laboratory-supplied jars appropriate for the analysis to be performed. The FT will label jars in the field, using permanent waterproof ink, with the following information: the unique sample number, date and time of sampling, initials of collector, laboratory analysis, and preservation method. All water samples will be unfiltered. Immediately after collection, the samples will be placed into a designated sample cooler maintained at approximately 4 ºC with ice substitute.

At the completion of sampling, the tubing will be disconnected from the pump, removed from the well, and disposed as described in Section 4.2.1. All pertinent information, including the time and date of sample collection, will be recorded on the Monitoring Well Sampling Log.

If using a microbailer, new cord will be securely attached to the ¾-inch-diameter disposable bailer. The bailer will slowly be lowered into the well until filled, and slowly retrieved. The collected water will be slowly poured out the top of the bailer into the sample container. This procedure will be repeated until sufficient sample volume is obtained. The bailer and cord will be disposed as solid waste following collection of the sample; they will not be decontaminated.

3.0 FIELD QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The field QA/QC program includes collection of duplicate samples, equipment rinsate samples, and trip blanks. Descriptions of QA/QC samples are presented below.

3.1 Trip Blanks

A trip blank will be used to detect and quantify potential volatile organic chemical cross-contamination among groundwater samples or contamination from an outside source that may occur during sampling or transportation to the laboratory. One bottle set for each cooler containing VOC samples will be filled with deionized water by the laboratory prior to field mobilization. These bottles will be transported to the sampling location and returned to the laboratory in the cooler used to transport groundwater samples. The trip blank will be analyzed for the same volatile organic parameters as groundwater samples. The concentration of any artifact found in the trip blank will be noted in the final report and compared to groundwater-sample results.

3.2 Duplicate Samples

Duplicate samples will be collected during each groundwater sampling event from locations with the highest potential to be contaminated, based on groundwater direction. To collect the temporary well duplicate, two complete sets of sample bottles will be filled with groundwater from the selected well. One set will be labeled as the “sample” (i.e., normal labeling procedure will be followed); the other set will be labeled as a “dummy sample” using the normal labeling procedure but with a “dummy” number that can be tied to the well by sampling personnel but not by laboratory personnel. The location of the duplicate sample(s) will be entered into the Monitoring Well Sampling Log. This duplicate will be analyzed using the same analytical methods used for the primary sample. Results of the analysis from this duplicate will be used as a check for repeatability in the analytical procedures. Duplicates will be collected at a rate of one per 10 field samples, with a minimum of one.

3.3 Equipment Rinsate Sample

Following equipment decontamination, an equipment-rinsate sample will be collected using distilled water poured over and through the decontaminated tooling. The rinsate will be collected into laboratory-prepared sample containers and analyzed as a normal field sample. One equipment-rinsate sample will be collected for this project, and submitted to the analytical laboratory for determination of the target analytes by the methods described in Section 6.0.

3.4 Sample Numbers

Sample numbers will consist of unique identification numbers.

3.5 Sample Containers

Containers used to transport samples for laboratory analyses will be provided by the laboratory performing the analyses. The bottles will be prepared by the laboratory according to the method used for analysis. The bottles will not be opened until immediately before samples are to be collected.

3.6 Sample Preservation and Handling

Sample preservation is intended to (1) retard biological action; (2) retard hydrolysis; and (3) reduce absorption effects. Preservation methods include pH control, refrigeration, and protection from light. Table 1 lists analytical parameters, analytical methods, sample container requirements, and preservative requirements for the groundwater samples.

Chemical preservatives will be added to the sample containers by the laboratory performing the analyses. Samples will be preserved in the field by placing the samples in an insulated cooler containing frozen “gel ice” immediately after sample collection. Upon receipt of the samples, authorized laboratory personnel will store and/or prepare the samples for analysis, taking into consideration sample holding times for the analytical parameter of interest.

3.7 Sample Shipping

Sample bottles will be wrapped in “bubble wrap,” placed into the cooler, and packed with frozen gel ice, with packing material as necessary to prevent bottle breakage. A temperature blank will be placed in the cooler prior to shipment. Sample coolers will be labeled for shipment or transfer to the appropriate laboratory. To the extent practical, samples will be shipped as a single sample delivery group, and may be held by the field technician prior to shipment, if necessary. All VOC samples will be shipped in the same cooler to minimize the need for multiple trip blanks.

If shipment directly to the laboratory is necessary, each cooler will be custody-sealed as described in Section 5.2. If the cooler is to be transferred to a local sample-receiving office, the custody seal will be added by the sample-receiving office before shipment to the laboratory. When custody is to be relinquished to a shipper, field personnel shall contact the laboratory-sample custodian to inform the laboratory of the expected time of arrival of the shipment, airway bill number, and any special requirements or time constraints on sample analysis. Any special conditions or requirements shall be noted on the Chain-of-Custody (COC) Record (Appendix B).

4.0 EQUIPMENT DECONTAMINATION AND INVESTIGATION-DERIVED WASTE MANAGEMENT

4.1 Decontamination

All non-disposable equipment and tooling introduced into a temporary well, or coming in contact with water from a well, must be decontaminated prior to use and reuse. To the extent practical, sampling equipment and supplies will be single-use and will not need decontamination prior to disposal. Direct-push well casing and screens will be decontaminated and reused between temporary-well installations.

The decontamination procedures for all non-disposable sampling equipment and tooling will consist of:

1. non-phosphate detergent wash;
2. tap water rinse; and
3. three final distilled-water rinses.

Rinse water will be collected into purge buckets or barrels as discussed in Section 4.2.3. Disposable equipment, such as peristaltic pump tubing, will be disposed at the Fairbanks North Star Borough landfill.

As the well casing/screens are currently expected to be re-used during the investigation (i.e., requiring decontamination between well completions), Shannon & Wilson will collect one representative equipment-rinsate sample following the decontamination of the equipment, as described in Section 3.3.

4.2 Investigation-Derived Wastes

Investigation-derived waste (IDW) will include purge water from temporary wells and sampling-equipment decontamination fluids.

4.2.1 Sampling Equipment

Used disposable nitrile gloves and peristaltic pump tubing or microbailers and cord will be placed in a garbage bag and disposed at the Fairbanks North Star Borough landfill as ordinary solid waste.

4.2.2 Purge Water

Buckets or barrels will be used to collect purge water from the wells, to be disposed in the refinery's wastewater treatment system, following coordination with refinery environmental staff.

4.2.3 Decontamination Fluids

Used soapy and rinse water from sampling-equipment decontamination will be placed in 5-gallon buckets or other suitable containers and disposed in the refinery's wastewater treatment system, following coordination with refinery environmental staff.

Decontamination of the driller's tooling will be performed on the refinery property; wash water will be collected for treatment in the refinery's wastewater treatment facility.

5.0 SAMPLE AND FIELD DOCUMENTATION

A sample documentation program will be implemented to document possession and handling of water samples from field collection through laboratory analysis. The program will include:

- sample labels that clearly identify samples;
- sample-cooler custody seal to preserve the integrity of the samples from the time the cooler is packed for shipment until it is opened in the laboratory;
- Monitoring Well Sampling Log to record information about each sample collected during the program;
- COC Records to establish sample possession from the time of collection to analysis, serve as official communication to the laboratory of the particular analysis required for each sample, and provide further evidence COC is complete; and
- laboratory documentation recording pertinent information about the sample on the sample-receipt form.

5.1 Sample Labels

To prevent misidentification of samples, legible labels will be affixed to each sample container. Labels will be sufficiently durable to remain legible even when wet, and contain the following information:

- sampling point identification name/number;
- name or initials of collector;
- date and time of collection;
- sample preservative and
- analysis required.

5.2 Chain of Custody Seals

In cases where samples are to be shipped out of town by commercial carrier, chain of custody (security) seals will be placed on the sample shipping container to ensure samples are not disturbed during transport. Two seals will be placed on the front and two on the back of the cooler, across the closure. The seals will be signed and dated by sampling personnel.

5.3 Temporary Well Construction Details

The Monitoring Well Construction Details form will be completed by the field technician observing the temporary well installation, recording:

- well identification and location;
- date/time of installation;
- name of driller;
- well-casing diameter;
- well depth;
- casing material and size;
- screen material, slot size, and length; and
- depth of screened interval.

5.4 Monitoring Well Sampling Log

A Monitoring Well Sampling Log will be maintained for groundwater sample-collection activities. The following specific data will be documented, where applicable:

- name of collector;
- identification of sampling point;
- total well depth;
- well purging/sampling method;
- purge water flow and field monitoring data;
- volume of water purged;
- analytical methods requested;
- weather conditions including air temperature;
- sequence and time of field activities conducted;
- groundwater parameters; and
- sample observations (color, odor, etc.).

5.5 Chain-of-Custody Records

Evidence of collection, shipment, laboratory receipt, and laboratory custody until completion of analyses will be documented using a COC Record containing the signature of individuals collecting, shipping, and receiving each sample. The COC Record must be signed and dated by a member of the sampling team. An example of the COC Record is included in Appendix B.

A sample is considered to be in custody if it is:

- in a person's actual possession;
- in view, after being in physical possession;
- sealed so no one can tamper with it, after having been in physical custody; or
- in a secured area, restricted to authorized personnel.

A COC Record will be used by all personnel to record collection and shipment of all samples. A qualified laboratory will not accept samples for analysis without a correctly prepared COC Record. The COC procedure is as follows:

- A COC Record will be initiated by the sampler/s and will accompany each set of samples shipped to the laboratory.
- Each sample will be assigned a unique identification number entered on the COC Record. Samples can be grouped for shipment on a common form.
- Each time responsibility for custody of the samples changes, receiving and relinquishing custodians will sign the record and denote the date and time.
- If the samples are shipped to the laboratory by commercial carrier, the COC Record will be sealed in a watertight bag, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier. The carrier waybill will serve as an extension of the COC Record between the final field custodian and receipt in the laboratory.
- Upon receipt in the laboratory, a designated individual will open the shipping containers, compare the contents with the COC Record, and sign and date the record. Any discrepancies will be noted on the COC Record or the laboratory's sample receipt form.
- If discrepancies occur, the samples in question will be segregated from normal sample storage and the field personnel notified for clarification.
- The COC Record is completed after sample disposal. Samples not consumed during analysis will be kept for six months or as otherwise established by the laboratory.
- COC Records, including waybills, will be maintained as part of the project record.

6.0 ANALYTICAL METHODS

6.1 Laboratory Selection

SGS Environmental Services, Inc. (SGS) in Anchorage, Alaska, will be used for analysis. SGS is an ADEC-approved laboratory for contaminated-sites analysis. SGS maintains a written QA/QC program that conforms, as a minimum standard, to QA/QC protocol set forth in the Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste, SW-846, November 1986, or subsequent approved versions of this testing protocol. The laboratory will provide a copy of the QA/QC plan for review upon request by the ADEC. The laboratory will be certified by the ADEC for analyses performed for this monitoring program, where such certifications exist.

Shannon & Wilson will submit groundwater samples from each well and depth to SGS for analysis of whole fuels by Alaska Method AK101/102/103, VOCs by (EPA Method 8260B, SVOCs by EPA Method SW8270D, and Resource Conservation and Recovery (RCRA) metals by EPA Method SW6020/7471B. Laboratory analysis will be requested on the COC record. We will request the laboratory report the data using their standard data-turnaround time (10 to 14 working days for most analyses).

6.2 EPA-Approved Methods and Sample Requirements

The analytical parameters, appropriate test method for each parameter, and test method detection limit to be applied to samples collected at the FHRA facility are identified in Table 1. Test methods listed in Table 1 are taken from the EPA Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846 (latest edition); and the ADEC Underground Storage Tanks Procedures Manual, November 7, 2002, for the whole fuels methods. All water samples will be un-filtered.

Table 1 lists the practical quantitation limits, as well as container and preservative requirements and holding time for analyses.

6.3 Analytical Methods

6.3.1 Whole Fuel Analysis

GRO water-sample containers will contain a pre-measured amount of hydrochloric acid (HCl), prepared in the laboratory. The HCl is a preservative; sample containers for GRO must not be rinsed or overflowed during sample collection. Sample containers for GRO (three 40-mL amber volatile organic analysis [VOA] vials with septum lids) will be completely filled with water. Water will be collected from the well slowly, in order to minimize agitation of the sample. Bottles will be filled to ensure there is no air trapped in the bottle. Water will be slowly collected into the sample bottle until a convex meniscus forms above the lip of the bottle. Once capped, the bottle will be checked for air bubbles by turning it upside down, tapping the cap of the inverted bottle, and visually inspecting the bottle for occurrence of air bubbles. If bubbles are observed, the bottle will be uncapped; sample added and rechecked using the same procedures until no bubbles are present.

Water samples to be analyzed for DRO and RRO are placed in two 250-mL amber glass bottles with Teflon-lined lids. Sample containers will contain a pre-measured amount of HCl, prepared in the laboratory.

6.3.2 Volatile Organic Compounds

VOC groundwater sample containers and collection procedures are exactly the same as for GRO samples (see Section 6.3.1), but the samples will be placed in separate containers.

6.3.3 Semivolatile Organic Compounds

Water samples collected for SVOC analysis will be placed in two 1-liter amber glass bottles without preservative. Sample bottles will be filled to the shoulder of the bottle.

6.3.4 RCRA Metals

Water samples to be analyzed for metals are placed in a 250-mL HDPE bottle. Sample containers will contain a pre-measured amount of nitric acid, prepared in the laboratory.

6.3.5 Sulfolane

Sulfolane groundwater sample containers and collection procedures are the same as for SVOC samples (see Section 6.3.3), but the samples will be placed in separate containers.

7.0 EVALUATION OF DATA QUALITY

QA and QC are important components of an environmental site investigation. QA is the integrated program for measuring the reliability of the data. QC is the routine use of specific procedures set forth so defined standards of sampling and analysis are met. This QA/QC plan describes specific procedures to be followed so the laboratory data are effective and do not detract from the quality or reliability of the results.

7.1 Quality Control Samples

QA/QC samples, including field-duplicate samples, will be submitted for laboratory analysis. At least one field duplicate sample will be collected at a minimum rate of 10 percent of the samples submitted for laboratory analysis. Duplicates will be assigned a separate, “dummy” sample number and submitted “blind” to the laboratory. Duplicate sample results will be used to test the comparability of analytical data.

Trip blanks will be used to detect and quantify potential volatile organic chemical cross-contamination among groundwater samples or contamination from an outside source that may occur during sampling or transportation to the laboratory. One bottle set for each cooler containing VOC samples will be filled with deionized water by the laboratory prior to field mobilization. These bottles will be transported to the sampling location and returned to the laboratory in the cooler used to transport groundwater samples. The trip blank will be analyzed for the same volatile organic parameters as the groundwater samples. The concentration of any artifact found in the trip blank will be noted in the final report and compared to the groundwater sample results.

Following equipment decontamination, an equipment-rinsate sample will be collected using distilled water poured over and through the decontaminated tooling. The rinsate will be collected into laboratory-prepared sample containers and analyzed as a normal field sample. One equipment-rinsate sample will be collected for this project, and will be submitted to the analytical laboratory for determination the target analytes by the methods described in Section 6.0.

Temperature blanks, while not QA/QC samples per se, enable the receiving laboratory to determine the temperature at which the samples arrive at the lab. Temperature blanks will consist simply of a jar filled with water and packed with the other samples in each cooler. The water temperature in the blank is measured at the laboratory. Sample temperature should be within a range of 2 ºC to 6 ºC. The laboratory will document cooler conditions, including measuring temperature blanks upon arrival at each laboratory location, and any occurrence of broken sample containers.

7.2 Data Quality Objectives

The QA objective for measurement data is to ensure environmental monitoring data are known and of acceptable quality. For analytical data, the objective is to meet acceptable QA standards of sensitivity, precision, accuracy, representativeness, comparability, and completeness. These terms are defined below:

> **Analytical sensitivity**: The laboratory objective for sensitivity is to measure a concentration at less than an analyte's cleanup level.
>
> **Precision** is a measure of mutual agreement among replicate or duplicate measurements of the same analyte. The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples, and shall be within the established control limits for the methods as published by the EPA. Field-sample precision will be measured as the relative percent difference (RPD) between the project's primary and duplicate samples.
>
> **Accuracy** is a measure of bias in a measurement system. Accuracy is expressed as the percent recovery of an analyte from a surrogate or matrix spike sample, or from a standard reference material. The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for these analytical methods on similar samples, and shall be within the control limits for the methods as established by the laboratory.
>
> **Representativeness** is a quality characteristic attributable to the type and number of samples to be taken so as to be representative of the environment. Sample locations will be selected in the field to be representative of the water at that sample location.
>
> **Comparability** is a qualitative parameter expressing the confidence with which one data set can be compared to another. The sampling method employed, methods used for the transfer of the samples to the analytical laboratory, and analytical techniques implemented at the laboratory shall be performed in a uniform manner.
>
> **Completeness** is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. The objective of completeness is to generate an adequate database to successfully achieve the goals of the investigation.

7.3 Reporting

The laboratory will be directed to provide a single laboratory report of all data. The laboratory will provide a Level 3 data report, which includes COC records, sample receipt form, copies of change orders and e-mail correspondence, an extended QC Report (including method blank, laboratory control sample [LCS]/laboratory control sample duplicate [LCSD], matrix spike [MS]/matrix spike duplicate [MSD], and duplicate data results), and raw data and chromatograms for the Alaska series whole fuels analyses. The laboratory case narrative will identify QA/QC deviations, and discuss anomalies or deficiencies with the analyses. The laboratory-data packet will be reviewed for QA, as described above. ADEC Data Review Checklists and a report case narrative describing data quality will be completed by Shannon & Wilson.

The laboratory is expected to achieve all stated reporting limits (limits of quantitation; LOQ) for the listed analytes. Any non-detects will be reported with the corresponding LOQ.

Matrix spike and matrix spike duplicate samples will be analyzed by the laboratory using a set of samples provided from the environmental samples on this project. Extra sample volume will be collected to accommodate this requirement. The laboratory will be instructed to perform the analyses for this project in a single SDG, and not split the analyses among two or more SDGs.

7.4 Missing Data Values

Care will be taken to complete all analyses in order to provide a complete data set.

7.5 Units of Measure

Units of measure will be specified after each quantity reported for the specific analyte.

8.0 HEALTH AND SAFETY

All personnel conducting monitoring well installation and sampling at the FHRA facility will conform to FHRA's site-specific health and safety policies. Shannon & Wilson sampling personnel will conduct sampling activities in accordance with the Shannon & Wilson Corporate Health and Safety Program. Other site-specific health and safety concerns will be addressed as part of the FHRA safe-work practices including site access, use of vehicles and equipment, and Occupational Safety and Health Administration compliance. FHR safe-work permits are required and must be kept at the work-site at all times.

9.0 DATA REPORT

Shannon & Wilson will prepare a report detailing the results of the investigation. The report will generally consist of following information.

- a brief project narrative;
- figure indicating the location of all sample points;
- discussion of any deviations from this SAP'
- a data table summarizing all data;
- a brief discussion of the data;
- conclusions derived from evaluation of the data;
- recommendations for additional work, if any;
- copies of all laboratory data;
- summary of the data validation; and
- additional supporting data as deemed necessary.

TABLE 1
SUMMARY OF DETECTION LIMITS, CONTAINERS, PRESERVATION, AND HOLDING TIMES
SAMPLING AND ANALYSIS PLAN
FLINT HILLS RESOURCES, LLC

Parameter	Medium	Analytical Parameters	Anticipated PQL	Analytical Method	Sample Container	Preservative	Holding Time
GRO	Water	GRO	100 µg/L	AK 101	3 x 40 mL AG, septum vials	HCl to pH < 2, Cool to 4 °C	14 days
DRO	Water	DRO	0.8 mg/L	AK102	2 x 250 mL AG	HCl to pH < 2, Cool to 4 °C	14 days
RRO	Water	RRO	0.5 mg/L	AK103	2 x 250 mL AG	HCl to pH < 2, Cool to 4 °C	14 days
Volatile Organics	Water	Benzene	0.4 µg/L	8260B	3 x 40 mL AG, septum vials	HCl to pH < 2, Cool to 4 °C	14 days
		Toluene	1 µg/L				
		Ethylbenzene	1 µg/L				
		Xylenes	3 µg/L				
		Other VOCs	0.4 - 5 µg/L				
Semivolatile Organics Compounds	Water	Sulfolane	10 µg/L	8270D	2 x 1 L AG	Cool to 4 °C	7 days
		Acenaphthene	0.053 µg/L				
		Acenaphthylene	0.053 µg/L				
		Anthracene	0.053 µg/L				
		Benzo(a)anthrocene	0.053 µg/L				
		Benzo(a)pyrene	0.053 µg/L				
		Benzo(b)fluoranthene	0.053 µg/L				
		Benzo(g,h,i)perylene	0.053 µg/L				
		Benzo(k)fluoranthene	0.053 µg/L				
		Chrysene	0.053 µg/L				
		Dibenzo(ah)anthracene	0.053 µg/L				
		Fluoranthene	0.053 µg/L				
		Fluorene	0.053 µg/L				
		Indeno(1,2,3-cd)pyrene	0.053 µg/L				
		Naphthalene	0.100 µg/L				
		Phenanthrene	0.053 µg/L				
		Pyrene	0.053 µg/L				
RCRA Metals	Water	Arsenic	5 µg/L	SW 6020	250 mL HDPE	HNO_3 to pH < 2, Cool to 4 °C	180 days
		Barium	3 µg/L				
		Cadmium	2 µg/L				

TABLE 1
SUMMARY OF DETECTION LIMITS, CONTAINERS, PRESERVATION, AND HOLDING TIMES
SAMPLING AND ANALYSIS PLAN
FLINT HILLS RESOURCES, LLC

Parameter	Medium	Analytical Parameters	Anticipated PQL	Analytical Method	Sample Container	Preservative	Holding Time
RCRA Metals	Water	Chromium	4 µg/L	SW 6020	250 mL HDPE	HNO_3 to pH < 2, Cool to 4 °C	180 days
		Lead	1 µg/L				
		Selenium	5 µg/L				
		Silver	2 µg/L				
		Mercury	0.2 µg/L	SW 7471B			
Groundwater Quality Parameters	Water	Temperature	0.1 °C	N/A	N/A	N/A	Measured in the Field
		pH	0.1 units	N/A	N/A	N/A	Measured in the Field
		Conductivity	1 µS	N/A	N/A	N/A	Measured in the Field
		Dissolved Oxygen	0.1 mg/L	N/A	N/A	N/A	Measured in the Field

Notes:

PQL Practical Quantitation Limit
N/A Not Applicable
AG Amber glass
HDPE High-density polyethylene
L Liter
mL milliliter
mg/L milligrams per liter
µg/L micrograms per liter

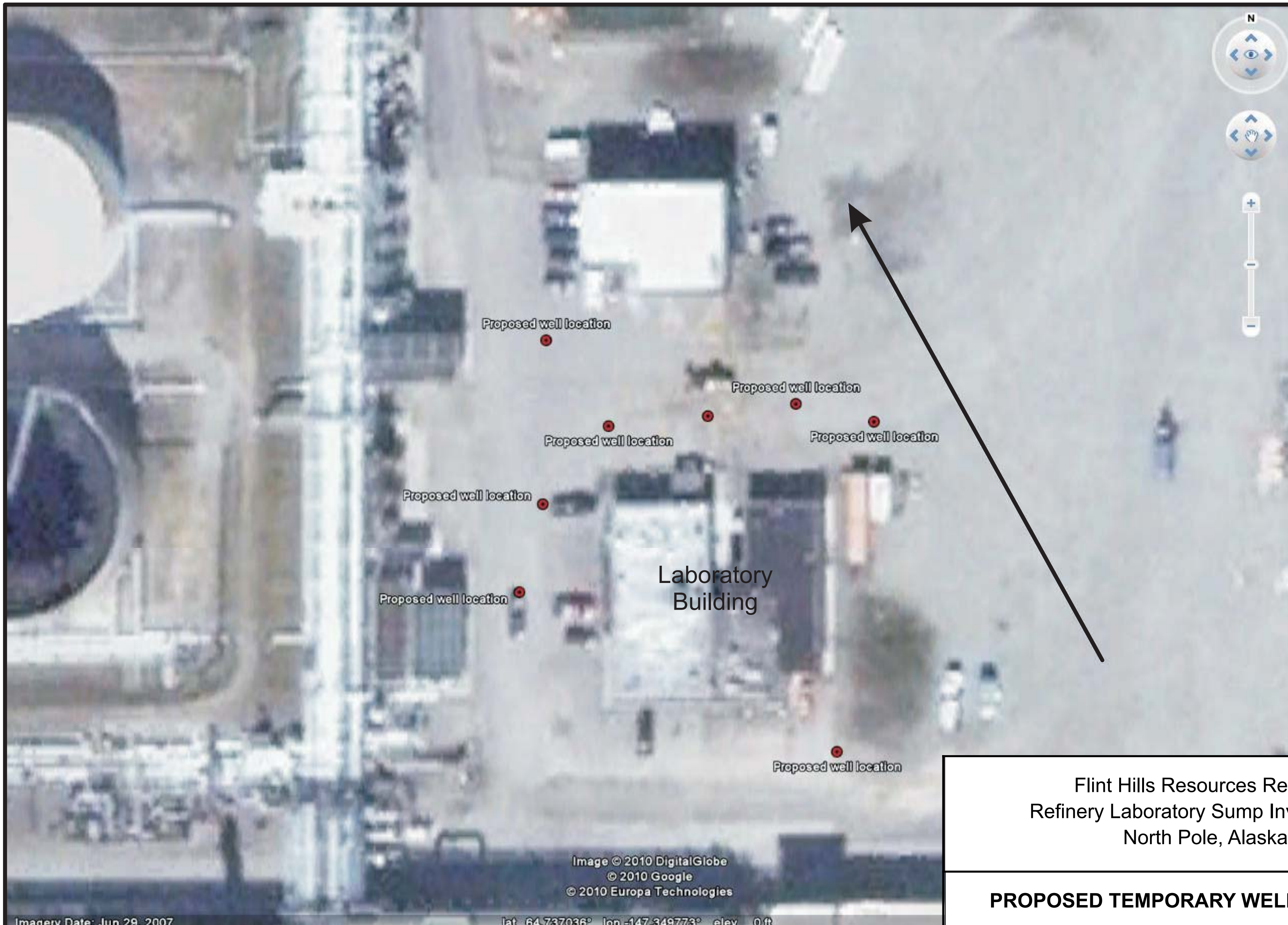

Photo date: June 29, 2007. Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth™ Mapping Service

Flint Hills Resources Refinery
Refinery Laboratory Sump Investigation
North Pole, Alaska

PROPOSED TEMPORARY WELL LOCATIONS

September 2010 | 31-1-11537-001

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Figure 1

Appendix A

Chemicals in Lab Sump

Chemicals in Lab Sump

METHYL CARBITOL SOLVENT (FSII)	trimethylbenzenes
naphtholbenzein	vacuum pump oil
phenol	Viscosity bath oil
phenolphthalein	water standard
phosphate buffer solution	xylenes
phosphoric acid	* (30-60% methanol,10-20% 1-pentanol, 5-15% imadazole, 5-25% dodecyldimethylamine)

Hydrocarbon Samples

ARC	HVY Kero
Asphalt	Incoming Crude
ASPHALT DEFOAMER	JP-4
BRT bottoms	JP-8
BRT feed	Kero raffinate
BRT ovhd	Kero recycle
Combined Return crude	LAGO
cooling kero	LSR
COREXIT 307 CORROSION INHIBITOR	LT Kero
CU1 stabilizer	LUBRIZOL 8195 GASOLINE ADDITIVE
Deprop bottoms	MDEA
Deprop feed	MONOETHANOL AMINE (MEA)
Desalted Crude	MORLIFE 5000 ASPHALT ADDITIVE
ETHYL ANTIOXIDANT 733 MDA 80	N Kero
ETHYL ANTIOXIDANT 733 PDA (D) 25	Naphtha
F-76	Naphtha raffinate
FHR Return Crude	Naphtha recycle
Full Kero	propylene glycol
Gasoline (unleaded)	S Kero,
HAGO	sulfolane
HITECH 6423 FUEL ADDITIVE	VGO
HITECH 6531 FUEL ADDITIVE	

Waters - samples & other

Desalter Water	Effluent wastewater
Crude OVHD water	Influent wastewater
C1 Stabilizer ovhd water	Gravel pit water
Deprop ovhd water	Gallery Pond water
Vacuum ovhd water	Fire water
BRT ovhd water	Cooling water for Octane Engines
Recovery ovhd water	Ice machine water
Benzene stripper	HVAC condensate
Boiler water	Deionizer condensate
Kero stripper ovhd water	Cooling water for Bomb Calorimeter

Chemicals in Lab Sump	
Cooling water for boiler	
NALCO Chemicals	
NALclean 8940	Nalco EC 5816A
NALclean 8960	Nalco EC 5828A
Nalco 5376	Nalco EC 5830A
Nalco 5403	Nalco EC2043a
Nalco 5541	Nalco EC5345A
Nalco 5541	Nalco EC5370A
Nalco 5602	Nalco EC5407A
Nalco 7320	Nalco SO771 indicator
Nalco 8735	Nalco SO771 N-2 Titrant
Nalco EC 5419A	Nalco SO780MQT-1
Detergents & cleaners	
409	Janitorial chemicals
A-33 Dry respirator cleaner	Joy
alcojet	neodisher A8
alcotabs	neodisher EM
citrus degreaser	neodisher N
Clorox	neodisher Z
Contrad 70	RBS solution
Contrex	Windex

Appendix B

Forms

MONITORING WELL CONSTRUCTION DETAILS

Monitoring Well No. ________________

Project Name ____________________
Project Number ____________________
Date Installed ____________________
Geologist/Engineer ____________________

Joint __ ________ Joint __ ________

________ ________

SECTION 3 **SECTION 6**

Blank ☐ Blank ☐
Slotted ☐ Slotted ☐

Joint __ ________ Joint __ ________

________ ________

SECTION 2 **SECTION 5**

Blank ☐ Blank ☐
Slotted ☐ Slotted ☐

________ ________
Joint __ ________ Joint __ ________

________ ________

SECTION 1 **SECTION 4**

Blank ☐ Blank ☐
Slotted ☐ Slotted ☐

________ ________
Joint __ ________ Joint __ ________

END CAP ________

Magnet ____________
Well stickup ____________

Total Length of Well ____________
Screen Depths below top of casing
Top ____________
Bottom ____________

WELL DATA

Pipe Type PVC ☐
Stainless Steel ☐
Other ____________

Diameter 2" ☐
4" ☐
Other ____________

Slot Size 0.010 ☐
0.020 ☐
Other ____________

SEALS

	Depth below ground surface From	To
Bentonite	________	________
	________	________
Pea Gravel	________	________
Concrete	________	________

MONUMENTS
Flush Mount ____________
Post ____________
Depth below surface ____________
Casing Stickup ____________

JOINTS
Type ____________
Pin end Down ☐
Up ☐

SAND PACK
Type or gradation ____________
Depth: ________ to ________

LOCKS Type ________
Key # ________

Length cutoffs, last section ________
____

MONITORING WELL SAMPLING LOG

Owner-Client Flint Hills Resources ______ Project No. ______
Location North Pole Refinery ______ Page ______
Sampling Personnel ______ Date ______
Weather Conditions ______ Well No. ______
Air Temp. (°F) ______

Method of NAPL measurement ______ NAPL thickness (feet) ______
Diameter & Type of Casing ______
Sample No. ______ Time ______ Time Started ______
Duplicate ______ Time ______ Time Completed ______

Measuring Point [MP] ______ MP Elevation ______
Height of MP [Above] [Below] Ground Surface ______
Water Level Elevation ______ Total Depth of Well Below MP ______
Depth to Water Below MP ______
Purging Method ______ Feet of Water in Well ______
Pumping Start ______ Gallons per foot ______
Pumping End ______ Gallons in Well ______
Purge Water Volume ______
Packer set at ______ feet below MP Purge Water Disposition ______
Ice at ______ feet below MP

FIELD PARAMETERS

Time	Temp [ºC]	Conductivity [µmhos per cm]	Dissolved Oxygen [mg per L]	pH	Eh [ORP] [mV]	Water Clarity [visual]

Sampling Method ______
Monitoring Well Condition ______
Sample Observations ______
Notes ______

Laboratory ______

Sample Containers	**Trip Blank**	
		Lab-Supplied
		S&W-Supplied

Tubing (feet) ______

Analyses	**Sample Containers**	**Preservatives**

WELL CASING VOLUMES

Diameter of Well [ID-inches]	1¼	2	3	4	6	8
Gallons per lineal foot	0.08	0.17	0.38	0.66	1.5	2.6

Shannon & Wilson, Inc.

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

1150 Olive Blvd., Suite 276
St. Louis, MO 63141
(314) 872-8170

2355 Hill Road
Fairbanks, AK 99707
(907) 479-0600

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

Chain of Custody Record

Page ______ of ______
Laboratory ____________
Attn: ____________

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab							Total Number of Containers	Remarks/Matrix

Project Information	Sample Receipt	
Project Number:	Total Number of Containers	
Project Name:	COC Seals/Intact? Y/N/NA	
Contact:	Received Good Cond./Cold	
Ongoing Project? Yes ☐ No ☐	Delivery Method:	
Sampler:	(attach shipping bill, if any)	

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time: ______	Signature: Time: ______	Signature: Time: ______
Printed Name: Date: ______	Printed Name: Date: ______	Printed Name: Date: ______
Company:	Company:	Company:

Instructions
Requested Turn Around Time:
Special Instructions:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Time: ______	Signature: Time: ______	Signature: Time: ______
Printed Name: Date: ______	Printed Name: Date: ______	Printed Name: Date: ______
Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ Laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

Laboratory Data Review Checklist

Completed by:

Title: Date:

CS Report Name: Report Date:

Consultant Firm:

Laboratory Name: Laboratory Report Number:

ADEC File Number: ADEC RecKey Number:

1. Laboratory
    a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

2. Chain of Custody (COC)
    a. COC information completed, signed, and dated (including released/received by)?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. Correct analyses requested?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation
    a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?
       ☐Yes ☐ No ☐NA (Please explain.) Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?
☐Yes ☐ No ☐NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?
☐Yes ☐ No ☐NA (Please explain.) Comments:

e. Data quality or usability affected? (Please explain.)
Comments:

4. <u>Case Narrative</u>

a. Present and understandable?
☐Yes ☐ No ☐NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?
☐Yes ☐ No ☐NA (Please explain.) Comments:

c. Were all corrective actions documented?
☐Yes ☐ No ☐NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?
Comments:

5. <u>Samples Results</u>

a. Correct analyses performed/reported as requested on COC?
☐Yes ☐ No ☐NA (Please explain.) Comments:

b. All applicable holding times met?
☐Yes ☐ No ☐NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?
 Yes No NA (Please explain.) Comments:

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?
 Yes No NA (Please explain.) Comments:

e. Data quality or usability affected?
Comments:

6. <u>QC Samples</u>

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?
 Yes No NA (Please explain.) Comments:

ii. All method blank results less than PQL?
 Yes No NA (Please explain.) Comments:

iii. If above PQL, what samples are affected?
Comments:

iv. Do the affected sample(s) have data flags and if so, are the data flags clearly defined?
 Yes No NA (Please explain.) Comments:

v. Data quality or usability affected? (Please explain.)
Comments:

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)
 Yes No NA (Please explain.) Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

☐Yes ☐ No ☐NA (Please explain.) Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?
Yes No NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain.)
Comments:

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)
Yes No NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)
Yes No NA (Please explain.) Comments:

iii. All results less than PQL?
Yes No NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?
Comments:

v. Data quality or usability affected? (Please explain.)
Comments:

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?
Yes No NA (Please explain.) Comments:

ii. Submitted blind to lab?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

f. Decontamination or Equipment Blank (If not used explain why).

☐Yes ☐ No ☐NA (Please explain.) Comments:

i. All results less than PQL?

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

Comments:

iii. Data quality or usability affected? (Please explain.)

Comments:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

☐Yes ☐ No ☐NA (Please explain.) Comments: